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MYOCARDIAL ISCHEMIA AND INFARCTION

A RELIABLE PORCINE CORONARY MODEL OF CHRONIC TOTAL OCCLUSION USING COPPER STENTS

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Background: Chronic total occlusion (CTO) of the coronary arteries are difficult to induce in large animal models. Copper stents, by causing inflammatory reactions, may provide a reliable means of gradual intra-luminal occlusion and valid evaluation of novel devices for CTO angioplasty. The aim of the present study was to create a percutaneous porcine model of CTO using copper stents.

Methods: To create an animal model of CTO, we implanted copper stents in the coronary arteries of 20 female swine (body weights: 25-30 kg). Copper stents, made using 23-gauge copper wire wrapped in a sinusoid pattern, were crimped on 3.0 mm angioplasty balloons and inserted into the mid-left anterior descending coronary arteries with appropriate sizing, approximately 1.1 : 1 stent : artery ratio. Five weeks later, the pigs were euthanized after follow-up coronary angiography and the arteries were examined histologically.

Results: Despite dual anti-platelet therapy (aspirin 100 mg and clopidogrel 75 mg daily) and successful stent implantation, a high percentage of pigs (13/20) died of stent thrombosis (acute: 7, subacute: 6). Complete follow-up and histological examination were possible in the remaining 7 pigs. Follow-up coronary angiography prior to sacrifice revealed total coronary occlusion in 3 pigs and near-total occlusive lesions in 4 pigs. All pigs with total occlusions showed good collateral flow (grade 2: 1, grade 3: 2). Histological studies revealed organized thrombus with fibrosis, calcification, and neovascular channels in the pigs with total occlusion; and organizing thrombus with persistent inflammation and destruction of the elastic laminas in the pigs with near-total occlusion. In the pigs with total occlusion, in particular, there was greatest density of fibrotic tissue at the proximal and distal ends of the occlusive lesions with softer, organizing thrombus in the middle, similar to CTOs developing in humans.

Conclusions: In a porcine model, CTO could be reliably induced by copper stent implantation with similar histology to that of human CTOs. This model may be useful in improving our percutaneous treatment of CTO, by providing an opportunity for testing novel coronary interventional devices.